

**WHAT IS CLAIMED IS:**

- 1        1.        An automatically adjusting annular jet mixer comprising:
  - 2                    a stationary hollow housing, and
  - 3                    a hollow inner nozzle member that moves axially within the housing
  - 4                    along a centerline of the housing in proportional response to
  - 5                    variations in pressure of supply water flowing to the housing.
- 1        2.        An automatically adjusting annular jet mixer according to Claim 1
  - 2                    further comprising:
    - 3                    said inner nozzle member attaching on one end to a pipe having a
    - 4                    powder inlet opening where powder is introduced into the inner
    - 5                    nozzle member,
    - 6                    said housing having at least one supply water inlet that admits
    - 7                    supply water to a downstream area located between the housing
    - 8                    and the inner nozzle member, a nozzle opening continuous with
    - 9                    said downstream area, and said nozzle opening formed between a
    - 10                  discharge end of the inner nozzle member and the housing to allow

11 supply water to flow via the nozzle opening to contact the powder  
12 which is flowing through the inner nozzle member.

1 3. An automatically adjusting annular jet mixer according to Claim 2  
2 further comprising:

3 an upstream area formed between the housing and the inner  
4 nozzle member and separated from the downstream area by a  
5 piston, said piston encircles and attaches to the inner nozzle  
6 member, said upstream area pressurized with a constant pressure,  
7 and said piston movably engaging an inner surface of said housing  
8 so that together the piston and inner nozzle member automatically  
9 move axially within the housing in response to variations in supply  
10 water pressure in the downstream area.

1 4. An automatically adjusting annular jet mixer according to Claim 3  
2 further comprising:

3 said discharge end of said inner nozzle member provided with a  
4 tapered section that cooperates with an inwardly tapered portion of  
5 the housing to form the nozzle opening.

1 5. An automatically adjusting annular jet mixer according to Claim 4  
2 further comprising:

3 said housing provided with an outwardly expanding tapered portion  
4 located adjoining the inwardly tapered portion and located between  
5 the inwardly tapered portion and a mixture exit opening of the  
6 housing.

1 6. An automatically adjusting annular jet mixer according to Claim 5  
2 further comprising:

3 a first helical groove provided in an external surface of said piston  
4 and extending between the upstream and downstream areas so  
5 that supply water flowing through the helical groove serves as a  
6 lubricant between the external surface of said piston and the inner  
7 surface of the housing as the inner nozzle member moves axially  
8 within the housing.

1 7. An automatically adjusting annular jet mixer according to Claim 6  
2 further comprising:

3 an alignment member attached to said housing at one end of the  
4 upstream area, said alignment member having an arm that extends  
5 parallel to and adjacent the inner nozzle member, and a traveling  
6 pin that inserts through a traveling pin opening provided in the arm  
7 is retained within a groove provided in the surface of the inner  
8 nozzle member as a means of preventing the inner nozzle member  
9 from rotating within the housing as the inner nozzle member moves  
10 axially within the housing.

1 8. An automatically adjusting annular jet mixer according to Claim 7  
2 further comprising:

3 a second helical groove provided in an inner surface of said  
4 alignment member and extending between the upstream area and  
5 a drain opening that is provided extending through in the alignment  
6 member and the housing so that regulated supply water flowing  
7 through the helical groove serves as a lubricant between the inner  
8 surface of the alignment member and the external surface of the  
9 inner nozzle member as the inner nozzle member moves axially  
10 within the housing.

1 9. An automatically adjusting annular jet mixer according to Claim 4  
2 wherein the means for pressurizing the upstream area at a constant  
3 pressure further comprises:

4 a pressure regulating valve providing supply water at a regulated  
5 pressure to the upstream area to pressurize the upstream area.

1 10. An automatically adjusting annular jet mixer comprising:

2 a hollow stationary mixer housing, and

3 a hollow inner nozzle member that moves axially within the housing  
4 along a centerline of the housing in proportional response to  
5 variations in pressure of supply water flowing to the housing,

6 said housing having at least one supply water inlet that admits  
7 supply water to a downstream area located between the housing  
8 and the inner nozzle member, a nozzle opening continuous with  
9 said downstream area, and said nozzle opening formed between a  
10 discharge end of the inner nozzle member and the housing to allow  
11 supply water to flow via the nozzle opening to contact powder  
12 which flows through the inner nozzle member.

1 11. An automatically adjusting annular jet mixer according to Claim 10  
2 further comprising:

3 an upstream area formed between the housing and the inner  
4 nozzle member and separated from the downstream area by a  
5 piston, said piston encircles and attaches to the inner nozzle  
6 member, said upstream area pressurized with a constant pressure,  
7 and said piston movably engages an inner surface of said housing  
8 so that together the piston and inner nozzle member automatically  
9 move axially within the housing in response to variations in supply  
10 water pressure in the downstream area.

1 12. An automatically adjusting annular jet mixer according to Claim 11  
2 further comprising:

3 a first helical groove provided in an external surface of said piston  
4 and extending between the upstream and downstream areas so  
5 that supply water flowing through the helical groove serves as a  
6 lubricant between the external surface of said piston and the inner  
7 surface of the housing as the inner nozzle member moves axially  
8 within the housing.

1           13.   An automatically adjusting annular jet mixer according to Claim 11  
2           further comprising:

3           an alignment member attached to said housing at one end of the  
4           upstream area, said alignment member having an arm that extends  
5           parallel to and adjacent the inner nozzle member, and a traveling  
6           pin that inserts through a traveling pin opening provided in the arm  
7           is retained within a groove provided in the surface of the inner  
8           nozzle member as a means of preventing the inner nozzle member  
9           from rotating within the housing as the inner nozzle member moves  
10          axially within the housing.

1           14.   An automatically adjusting annular jet mixer according to Claim 13  
2           further comprising:

3           a second helical groove provided in an inner surface of said  
4           alignment member and extending between the upstream area and  
5           a drain opening that is provided extending through in the alignment  
6           member and the housing so that regulated supply water flowing  
7           through the helical groove serves as a lubricant between the inner  
8           surface of the alignment member and the external surface of the

9 inner nozzle member as the inner nozzle member moves axially  
10 within the housing.

1 15. An automatically adjusting annular jet mixer according to Claim 11  
2 further comprising:

3 said discharge end of said inner nozzle member provided with a  
4 tapered section that cooperates with an inwardly tapered portion of  
5 the housing to form the nozzle opening.

1 16. An automatically adjusting annular jet mixer according to Claim 11  
2 further comprising:

3 said inner nozzle member attaching on one end to a pipe having a  
4 powder inlet opening where powder is introduced into the inner  
5 nozzle member.

1 17. An automatically adjusting annular jet mixer according to Claim 11  
2 further comprising:

3 said housing provided with an outwardly expanding tapered portion  
4 located adjoining the inwardly tapered portion and located between



5 the inwardly tapered portion and a mixture exit opening of the  
6 housing.

1 18. An automatically adjusting annular jet mixer according to Claim 11  
2 wherein the means for pressurizing the upstream area at a constant  
3 pressure further comprises:

4 a pressure regulating valve providing supply water at a regulated  
5 pressure to the upstream area to pressurize the upstream area.

1 19. A method for mixing guar gum mixtures comprising:

2 injecting a wettable powder through a hollow inner nozzle of an  
3 automatically adjusting annular jet mixer, and

4 pumping mix water into a downstream area provided in the  
5 automatically adjusting annular jet mixer between the inner nozzle  
6 and a hollow housing within which the inner nozzle axially moves  
7 so that the downstream area is pressurized and causes the inner  
8 nozzle to move relative to a housing of the mixer until the opposing  
9 forces exerted on the inner nozzle by the pressurized downstream  
10 area and an upstream area that is pressurized at a regulated

11 pressure are balanced and thereby adjusting the nozzle opening  
12 formed jointly by a tapered section of the inner nozzle and a  
13 inwardly tapered section of the housing so that high mixing energy  
14 is maintained to effectively wet the powder with the supply water as  
15 the supply water exits the nozzle opening, regardless of mixing  
16 rates.